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(71) Applicant(s)

LG Electronics Inc

(Incorporated in the Republic of Korea)

120 Yoido-Dong, Yongdungpo-Gu, Seoul,  
Republic of Korea

(72) Inventor(s)

Gyeong-Sang Lee

(74) Agent and/or Address for Service

Lloyd Wise, Tregear & Co

Commonwealth House, 1-19 New Oxford Street,  
LONDON, WC1A 1LW, United Kingdom

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(58) Field of Search

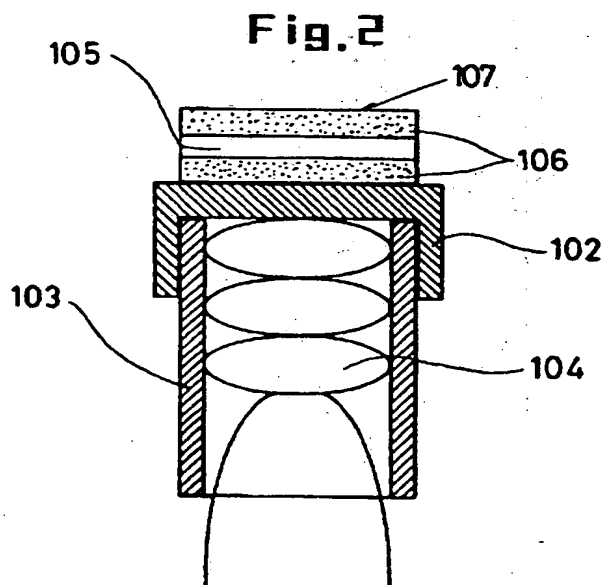
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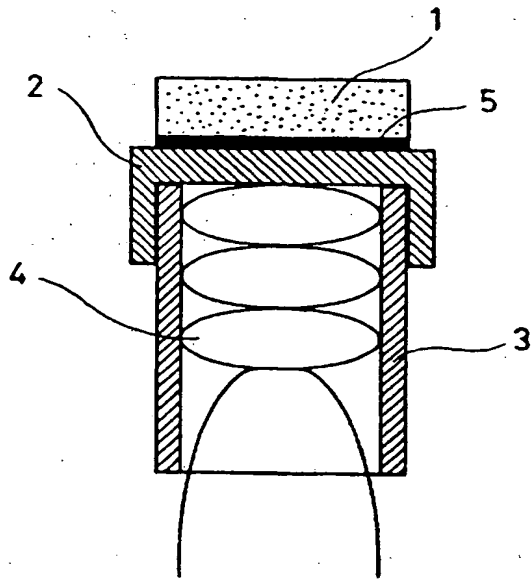
## (54) Cathodes

(57) An indirectly heated cathode comprises an emitter 107 comprising a laminate of an active metal 105 and electron emissive material 106. A layer of active metal may be sandwiched between two layers of electron emissive material, the layers being formed successively e.g. by printing or air spraying. The active metal may be Mg, Si, Zr, Mn, W, Th, Cr or Mo, and the electron emissive material is preferably a compound oxide of BaO with at least one of SrO, CaO, Sc<sub>2</sub>O<sub>3</sub> and Al<sub>2</sub>O<sub>3</sub>.

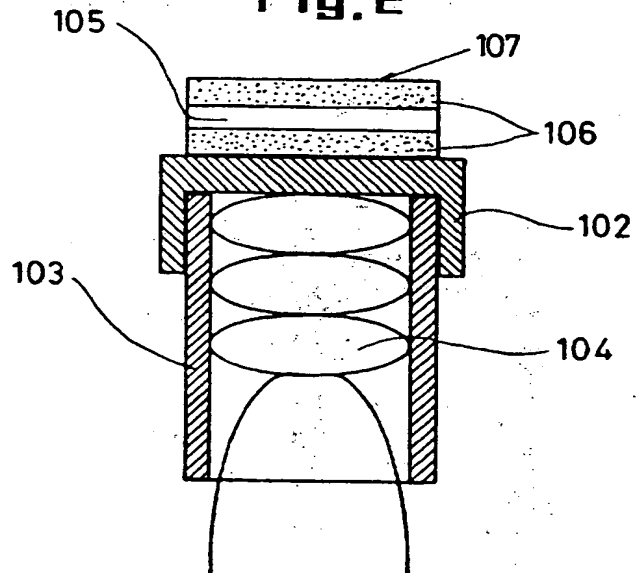


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**Fig. 1**  
**(Prior Art)**



**Fig. 2**



A CATHODE STRUCTURE BODY AND A METHOD  
OF COATING AN EMITTER

The present invention relates to a cathode structure body and a method of fabricating same. More particularly, the invention is concerned with the structure of the emitter coated on an end portion of a normally cylindrical cathode sleeve. The intention is to increase the cathode current density and extend the electron emission lifetime.

According to the invention, a cathode body comprises a sleeve housing a heater for a cathode and an emitter coated on an end portion of the sleeve, the emitter comprising a laminate of an active metal and an electron emission material. The end portion of the sleeve normally comprises a base metal closing the sleeve end, typically in the form of a cap.

The invention also provides a method of fabricating a cathode body including the step of applying to an end portion of a sleeve housing a heater for a cathode an emitter in the form of a laminate of an active metal and an electron emission material. Preferably, the emitter is applied by the successive deposition of coatings of the emission material and active metal.

The invention will now be described by way of example and with reference to the accompanying schematic drawings wherein:

Figure 1 shows the structure of a cathode body for a conventional cathode-ray tube.

Figure 2 shows the structure of a cathode body according to the invention for a cathode-ray tube.

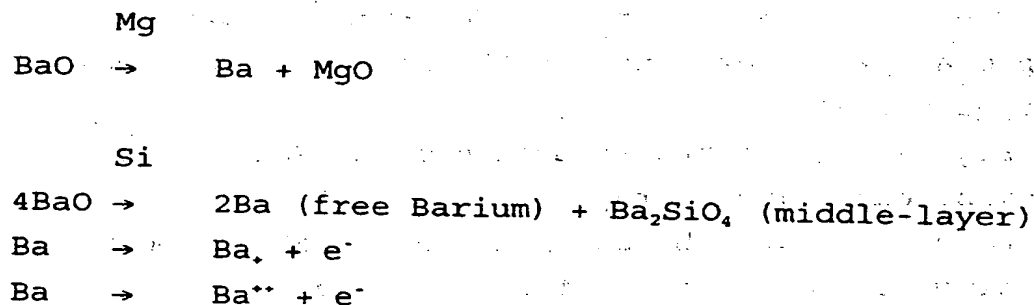
A cathode structure body for a conventional cathode-ray tube is shown in Figure 1 and has a base metal 2 of alloyed Ni containing a bit of active metal (for example, Mg, Si) in the form of a cap at the top of a cylindrical cathode sleeve 3 in which a heater 4 for heating a cathode is inserted. An emitter 1 of electron emission materials containing SrO, CaO, is mounted on

the top surface of the base metal 2, the main constituent being BaO. Also shown in Figure 1 is a high resistance middle-layer 5.

In the cathode-ray tube, the cathode functions to produce electrons from the emitter 1 fitted on the top of the base metal 2 by heating of the heater 4. A cathode current density is referred to as cathode current per unit surface area of a cathode emission body, generally means a peak current density at the center of electron emission.

Electron emission lifetime relates to the deterioration of electron emission, and the time that a cathode current is deteriorated by the 40-50% compared to an initial cathode current. Of the factors effecting the electron emission lifetime, the first is in defect of free Ba by means of defect of an active metal, the second is in defect of free Ba by means of evaporation of electron emission materials, and the third is the creation of a high resistance middle-layer 5 between the emitter 1 and the base metal 2.

The electron generating mechanism in a cathode structure body for a conventional cathode-ray tube is as follows:



In a cathode structure body for a conventional cathode-ray tube, an electron generation reaction takes place between electron emission materials of an emitter 1 and an active metal of a base metal 2. As a result, there is formed a middle-layer 5 of a high resistance

oxide layer. The middle layer 5 generates heat due to its high resistance when electrons are generated and discharged from a cathode pole, and damages the emitter 1. A contact reaction between an active metal of the base metal 2 and an electron emission material of the emitter 1, can bring about a rapid electron emission deterioration, whereby an electron emission lifetime is rapidly shortened.

In applying the emitter 1 to the top of the base metal 2, there is used an air spray coating method using a clean air pressure. A coating density is very low at about  $0.8-1.1\text{g/cm}^3$ . This means that cathode current density and electron emission lifetime is limited due to the evaporation of an electron emission material.

Typically, the electron emission of a cathode structure body for a conventional cathode-ray tube can be about 20,000 hours at an operable peak cathode current density of about  $2.5\text{ A/cm}^2$ .

Conventional cathode-ray tubes mainly use oxide cathode poles, but to achieve the high cathode current density according to the large size and fixture and fine and high brightness of recent cathode-ray tubes, a dispenser cathode has been developed and used. However dispenser cathodes are expensive, and the fabricating process is very complicated.

Figure 2 shows the construction of a cathode structure body of the present invention. A base metal 102 in the form of a cap, supports an emitter 107 on the upper end of a cylindrical cathode sleeve 103 in which a heater 104 for heating a cathode is inserted and installed. The emitter 107 has an active metal 105 and electron emission materials 106 coated in various steps on the top surface of the base metal 102.

The main constituent of the electron emission material 106 is  $\text{BaO}$ , which is a compound oxide containing at least one of  $\text{SrO}$ ,  $\text{CaO}$ ,  $\text{Sc}_2\text{O}_3$ ,  $\text{Al}_2\text{O}_3$ . The active metal 105 is a metal for generating a free Barium

in the reactions with Barium oxide, and comprises at least one of Mg, Si, Zr, Mn, W, Th, Cr, Mo.

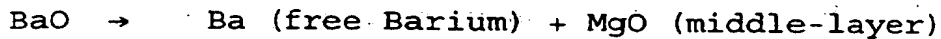
5 An effective method of coating on the top surface of the base metal 102 the emitter 107 composed as above, comprises coating the electron emission materials 106 and the active metal 105 in various times, and in turns. When the electron emission material 106 and the active metal 105 are mixed and coated, the distribution is not uniform even though there is used any one method such as  
10 a print method or a spray method. In the preferred method of coating the emitter 107 firstly the electron emission material 106 is applied to the top of the base metal 102, and the active metal 105 on the surface of the electron emission material 106, which can be  
15 effective to structure the emitter 107 without breaking away the active metal 105.

In coating the electron emission material 106, it is possible to use a conventional spray method. However, there is also a print method for applying a  
20 constant pressure to increase the coating density of the emitter 107. The coating thickness per once is less than or equal to 20 $\mu$ m, if so, there is possible the reaction between the active metal 105 and the electron emission material 106. In the system, the active metal  
25 105 should be a fine powder and it is effective to use a dry air spray method in order to obtain an uniform distribution of the active metal.

In the cathode structure body for a cathode-ray tube, when there are provided the electron emission  
30 material 106 whose main constituent is a Barium oxide, an Aluminium oxide on the top surface of the base metal 102 of alloyed Ni containing Mg, Si, and the emitter 107 composed of the active metal 105 of Tungsten powder, the electron generation mechanism is as follows:

35 i) the electron generation mechanism between the electron emission material 106 and the base metal 105.

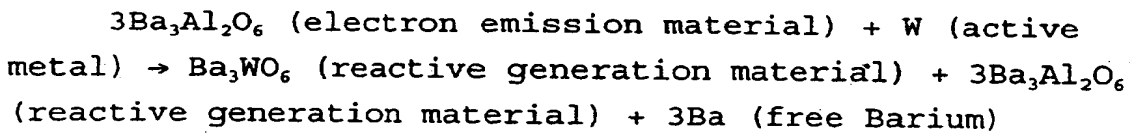
Mg



Si



10 ii) the electron generation mechanism between the electron emission material 106 and the active metal 105 in the emitter 107.



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20 In the cathode structure body for the cathode-ray tube of the present invention quantities of free Barium are generated as compared to a conventional cathode structure body. The reactive generating material between the electron emission material 106 and the active metal 105 in the emitter 107 is generated on the

25 broad power surface of the active metal 105, different from a middle-layer of the reaction generating material between the electron emission material 106 the base metal 102. This is not the factor of the electron emission deterioration as there is little generated in

30 the middle-layer between the electron emission material and the base metal relative to a convention method. It is possible to improve the electron emission lifetime because the electron emission deterioration can be restricted by means of the middle-layer between a

35 conventional electron emission material and the base metal.

Furthermore, since the preferred coating methods of

the emitter of the present invention are a print method of coating the electron emission material 106 by the pressure, and an air spray method of coating the active metal 105, there can be obtained the emitter 107 of the uniform active metal 105 and increased coating density of the electron emission material 106 more than  $1.2\text{g/cm}^3$ . As a result, the cathode current density and the electron emission lifetime can be increased since the evaporation of the electron emission material 106 can be restricted in operating the cathode.



CLAIMS

1. A cathode body comprising a sleeve housing a heater for a cathode and an emitter coated on an end portion of the sleeve, the emitter comprising a laminate of an active metal and an electron emission material.

2. A body according to Claim 1 wherein the end portion of the sleeve comprises a base metal closing the sleeve end.

3. A body according to Claim 1 wherein the laminate comprises the active metal between two layers of electron emission material.

4. A body according to any preceding Claim wherein the active metal comprises at least one of Mg, Si, Zr, Mn, W, Th, Cr, Mo.

5. A body according to any preceding Claim wherein the electron emission material comprises Barium oxide as its main constituent and at least one of SrO, CaO,  $Sc_2O_3$ ,  $Al_2O_3$ .

6. A body according to any preceding Claim wherein the coating thickness of the electron emission material is no more than  $20\mu m$ .

7. A cathode body substantially as described herein with reference to Figure 2 of the accompanying drawing.

8. A method of fabricating a cathode body including the step of applying to an end portion of a sleeve housing a heater for a cathode an emitter in the form of a laminate of an active metal and an electron emission material.

9. A method according to Claim 8 wherein the emitter is applied by the successive deposition of coatings of the emission material and active metal.

10. A method according to Claim 8 or Claim 9 wherein the laminate comprises the active metal between two layers of electron emission material.

11. A method according to any of Claims 8 to 10

wherein the electron emission material is coated by one of a print method and an air spray method.

12. A method according to any of Claims 8 to 11 wherein the active metal is coated by an air spray method.

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13. A method of fabricating a cathode body substantially as herein described with reference to Figure 2 of the accompanying drawings.



Application No: GB 9626424.7  
Claims searched: all

Examiner: Martyn Dixon  
Date of search: 23 January 1997

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H1D (DPA,DU)

Int Cl (Ed.6): H01J (1/14,1/142,1/144,1/20,1/24,9/04)

Other: online: WPI

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 0994151 A (Philips) see metal-containing layer 3 and emissive layer 4	1,2,5,8,9 11,12
X	GB 0929002 A (Philips) see active layer 3 and emissive layer 5	1,2,4,5
X	EP 0560436 A (Philips) see metal layer 3 and emissive layer 4, and WPI Abstract Accession No. 93-289279/37	1,2,4,5
X	EP 0445956 A (Mitsubishi) see metal layer 14 and emissive layer 15	1,2,4, 5,8,9

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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